

Study Group 1

ELECTRONIC FUNDAMENTALS

HOW TO STUDY – EFFECTIVELY

Service Practices 1:

HOW TO IDENTIFY
RECEIVER PARTS

Service Practices 2:

HOW TO USE TOOLS



RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

New York,

N. Y.



ELECTRONIC FUNDAMENTALS

HOW TO STUDY – EFFECTIVELY

1. Preparing for Study

2. Study Methods



RCA INSTITUTES, INC.

A SERVICE OF RADIO CORPORATION OF AMERICA

HOME STUDY SCHOOL

350 West 4th Street, New York 14, N. Y.



"The most important factor to keep in mind is to continue your education. Science and industry will reward you for your talents and energy. There is everything good yet to be accomplished in our lives and in our work. What man has done, man can do better."

David Sarnoff

Chairman of the Board
Radio Corporation of America

YOUR FUTURE

You are fortunate in having developed an interest in the field of electronics. A knowledge of electrical and electronic circuits, which this course gives you, will prepare you to take advantage of the many opportunities that exist today for trained technicians. In fact, no other field offers so many job possibilities as are found in electronics. This course is designed to give you a thorough background in general electronics, stressing basic radio theory and practical training. This background is essential to any advanced work in the field of electronics. There are many other careers toward which you might aim that require the same basic knowledge that this course provides. There are opportunities in broadcasting, television servicing, public address, industrial electronics, computers, etc. You have shown an interest in this field. We hope that you will maintain your interest and let nothing stand in the way of your electronics career.

Don't, even for a moment, think that your study of electricity and electronics will not cost you many hours of study and hard work. These lessons are not pink, sugar-coated pills of wisdom that you can swallow between supper and a movie or between dances. In fact, if you really mean to go ahead and get a sufficient knowledge of electronics to prepare you for a worthwhile job, you are going to have to work for it and possibly give up many an hour to study that you would rather spend in social activities, listening to the radio or television, or going to a dance or movie. When you do so, realize that the rewards will well repay you for any minor sacrifices that you may have to make. Once you have accepted the fact that learning anything worthwhile takes time, effort, and practice, you will have taken the first step towards success.

The one person who is responsible for your ultimate success or failure is you. Because this is so, let us speak for a moment of the things you may think or do that may stand in your way. First, you must have the will to learn, even if it means that you *must* work for knowledge. Your will to learn may sometimes weaken because of a temporary lack of interest, resistance to learning something difficult, or just plain laziness. At such times, you must remind yourself of what success in this course will mean to you and get back on the job.

There are students who, for one reason or another, become easily discouraged; when a lesson becomes difficult to understand. With little encouragement, they are willing to give up the whole thing and say that the subject is beyond their capacities. Should you, however, begin to doubt yourself, remember that thousands of people, much like you, have successfully learned electronics and are now successfully working in the field.

Perhaps you may think (if you are an older man) that you are too old to learn electronics. You may even think that "you can't teach an old dog new tricks", but don't you

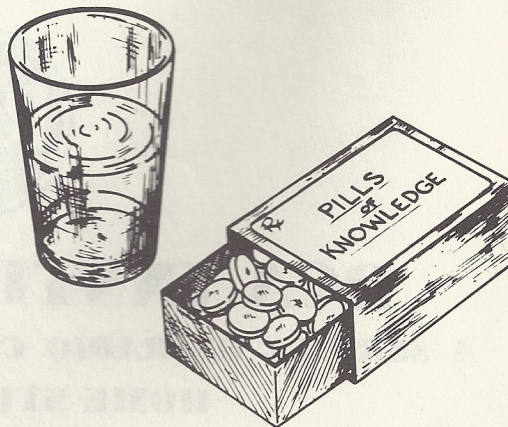


Fig. 1

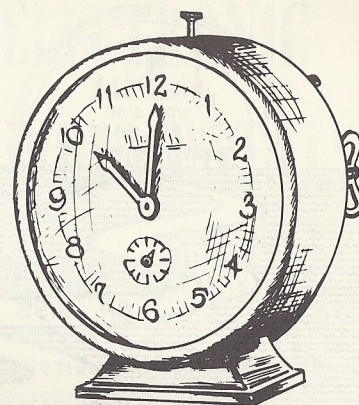
believe it. Between the ages of 22 and 50, your ability to learn a scientific subject declines no more than one percent a year, and this decline is more than compensated for by your ability to exercise judgment, the ability that comes in these later years. In our youth, we learn faster but more haphazardly; in our more mature years, we learn the important things and pass up the useless frills. So never say or even think that you are too old to learn.

Above all, never be guilty of saying "I could learn about electronics, radio, television, or any other subject, if I only had the time. Even those of us who seem to be busy all the time fritter away many an hour in any week. Learn to *make* the time and *take* the time to learn. You will discover that a few minutes spent now and then, in an effort to learn, pay large dividends. In fact, sometimes it is possible to learn more in a series of 5 or 10 minute study periods than could be learned in one session using the same total amount of time. We will speak more about this shortly.

1. PREPARING FOR STUDY

If you are like most people, you may never have learned how to study efficiently. This is not your fault. It is more the fault of your training in school or out of school. Except in certain modern schools and colleges, study methods are never taught, except to problem students. However, in taking this course, you are on your own, and your success in the course may well depend on your ability to study efficiently. So, even if you have never received any training in study methods until now, it will pay you to learn how you may best use your study time.

Budget Your Time. Each and every day you have 24 hours to spend. Let us assume that you spend 8 of them in sleeping and 8 in working. This leaves 8 hours to be spent in eating, recreation, and study. In addition, each weekend many people have more free time because they enjoy a 5-day work week. For most of us, this means that we have an average of 4 to 5 hours a day to spend in one way or another, which adds up to about 30 to 35 hours a week. Even if you spend



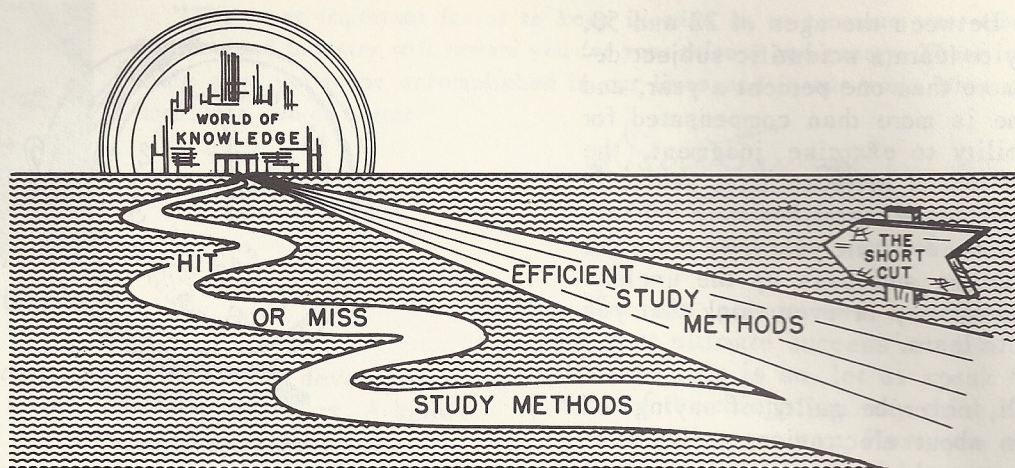
make time for study

Fig. 2

only half this amount of time in study and in doing your experiments, you can finish this course in less time than you may have thought possible until now. Your free time may be broken up into short periods or you may be able to set aside several hours in a row for study purposes. It does not matter much whether your study time is broken up or is in one piece. What is important is that you plan ahead so that you make full use of such time as you have. If you plan to study or work for several hours in a row, it is a good idea to take a five-minute break or rest period in each hour so that you can maintain your interest in what you are doing.

Your Physical Condition. Your success in studying depends in a great measure on your physical condition at study time. When you are physically tired, you may find it so difficult that you may become discouraged and think that the subject is too difficult for you. For that reason, it is a very good idea to rest a while before you study after a hard day's work. You may find that it pays to go to bed early, get up early, and do your studying before going to work. It may be that if you work very hard during the week that your most successful studying will be done during the weekends. If this is the case, be sure to plan your week-end study so that other things do not interfere with it.

Do not try to study just after eating a heavy meal. The blood rushes from your head to your stomach after eating, and makes you a bit drowsy, and in no mood for study. This being the case, do not prepare to study by raiding the ice-box,



take the right road

Fig. 3

for you probably will be more successful in your learning if you are just a little bit hungry. On the other hand you don't want to try to study when you are very hungry, because you may find it difficult to keep your mind away from the subject of food.

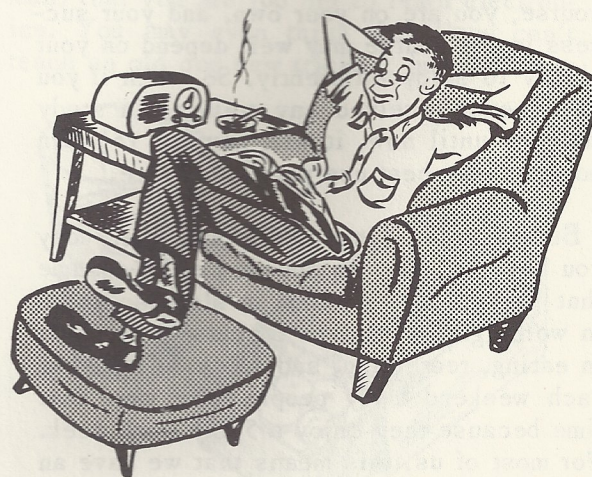
The Place For Study. It is a good idea to set aside a desk, a table, or a bench, just for the purpose of studying these lessons. There is a good reason for this. You will begin to associate the desk, table, or bench with your study and when you sit down to work, you will find that it is easy to get into the mood for study. The chair that you sit in should not be too comfortable. The chairs or benches that you sat in when attending school were designed to keep you awake and mentally alert. So the chair you choose should not be one that will invite you to rest, because in studying electricity and electronics, you will need to be alert and have all your wits about you.

The desk, table, or bench should not be cluttered up with things that will distract you or take your mind off what you are doing. It should be clear of all things, except the lesson booklets, paper, pen or pencil, and the other things with which you may need to work. If your work place is near an open window, it's better that you seat yourself so that your back is to the window so that you won't be tempted to look out the window. For the same reason, you should

not try to study and at the same time listen to the radio, phonograph, television set, or the conversations of people around you. To concentrate you should have quiet. This is not always easy to come by, so that it may take a little extra effort on your part and that of your family to see that you get the quiet that you need for study.

One more note about your surroundings. Make sure that you have good light to study in. With good light you can see better and will not tire as easily.

Getting Started. With time to study, with a place in which to work, and something to study, you can get started in only one way,



don't get too comfortable

Fig. 4

and that is by deciding that *now* is the time to study and by *getting at it!* This sounds very easy, but sometimes requires an extra bit of will power to do. This is the time when you have to remind yourself of what kind of future may be yours when you have finished the course.

2. STUDY METHODS

Each of your lessons consists of three parts: a Theory Lesson, an Experiment Lesson, and a Service Practices booklet. Each of these is treated in a different manner and for that reason is discussed separately in these paragraphs.

We will start off with the Theory Lesson. For example, with this booklet you receive your first Theory Lesson, your first Experiment Lesson, and your Lesson Assignment, which is a test that you take after you have completed the lesson, and which you send to us for grading. We will tell you about this lesson assignment a little later.

Let's assume that you are now planning to sit down and study Theory Lesson 1. How should you go about it? There are, of course, several ways in which you might start to study the lesson. While there is nothing that is going to force you to follow the method that we are about to suggest, we do hope that you will try it out, because it is a method that has proved successful with many students in all parts of the country. So, while you may have some ideas of your own on the subject or some pet method that you have used in the past, we urge you to read the following pages carefully and see if what we suggest makes sense.

If you turn to the title page of Theory Lesson 1, you would find that it is called WAVE MOTION AND COMMUNICATION. You would also find, under the title, that the lesson discusses *Sound, Wave Motion, Sound Waves, Wave Length and Cycle, Frequency, Audio Frequency, Radio Frequency, the Radio Communication System, and the Need for Basic Electrical Knowledge*. If you have ever read anything about wave motion before, you may already have an idea of what the lesson is about just by reading the title page. If, as

ELECTRONIC FUNDAMENTALS

THEORY LESSON 1

WAVE MOTION AND COMMUNICATION

- 1-1. Sound
- 1-2. Wave Motion
- 1-3. Sound Waves
- 1-4. Wave Length and Cycle
- 1-5. Frequency
- 1-6. Audio Frequencies
- 1-7. Radio Frequencies
- 1-8. The Radio Communication System
- 1-9. Need for Basic Electrical Knowledge



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Fig. 5

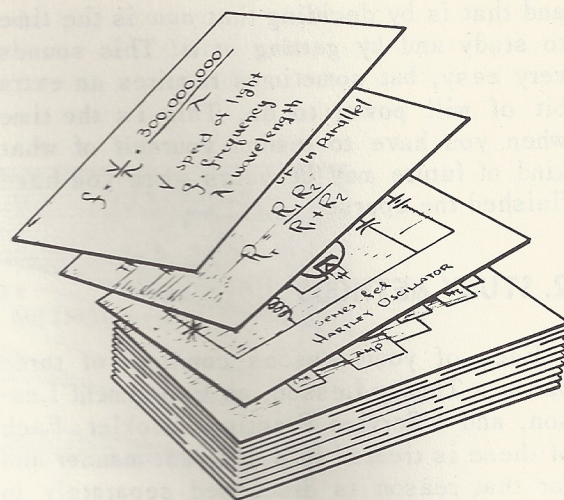
the case may be, *sound waves, wave length, and frequency* are brand new terms to you, then this list of topics does not tell you much. Even so, there are some words with which you are familiar. For instance, you must have heard the word *sound* and know that it refers to something that you can hear. You may not know exactly what we mean by the phrase *wave motion* but if you live anywhere near any body of water or have ever seen a moving picture of waves on a sandy beach, you know what a wave is and you probably can guess that *wave motion* must be something about the movement of a wave. So, even before you turn the title page to the first page of the lesson, you have some idea of what the lesson will discuss.

If you read the title page of a lesson in this way, you are taking the first step in

studying the lesson, because the first thing you should do in studying any lesson, any technical article in a magazine, or any page in a text book, is to find out what it is all about. Of course, reading the title page is only the beginning of this finding out process. The next step is to read the lesson, article, or page rapidly, to see if you can get a more complete idea of the subject without actually stopping to study any part of it. In so doing, you may see some words that are strange to you. In a lesson or in a page of a text book, new technical words are sometimes printed in italics (slanted letters). In our lessons, you will find that a word so printed is usually defined or its use is explained. You cannot hope to be able to read these lessons, unless you understand the meaning of each word as you come to it. This is true of even ordinary English words that are not technical words, and yet may be new to you. So, in this first rapid reading of the lesson read the definitions of any strange technical terms. If there is a general vocabulary word that is strange to you, you may find it necessary to look it up in the dictionary. The point that we are making now is that you must understand the meaning of each and every word before you settle down to actually studying the lesson.

Once you have discovered what the lesson is all about and what it is that you must learn, you are ready for the next step in studying. Before we discuss this step, however, it is necessary that we first talk about the way we learn things.

Rote Versus Understanding. We learn things in two ways. The first way is by *rote*, or memorizing. For example, in school when you were given the task of learning a poem or a song, you probably repeated the words over and over again, until you knew them by heart. We call this learning by rote, or memorizing. It's a good and effective method of learning things that cannot be learned in any other way. For example, many of us learn how to spell by rote. You may have learned the multiplication table by rote. But the silliest thing you can possibly do is to sit down and try to memorize Lesson 1 or any lesson in this course. Yet, there are parts of Lesson 1, and of other lessons that you



small file cards
for studying and review

Fig. 6

will study in this course, which you should memorize. For example, meanings of certain technical words you should learn pretty much by rote, so that you will understand them when you see them in the text. You will find formulas. For example, it is stated in Theory Lesson 1 that *wave length equals the velocity divided by the frequency*. Unless you are told not to, you should memorize formulas.

But formulas and the meanings of words make up only a small part of a Theory Lesson. The rest of the lesson must be studied, but as we have said, should not be learned by rote, which brings us to the other way of learning, which is by understanding. Sometimes it is much easier to learn by rote than it is to learn by understanding. By the same token, it is much easier to forget what you learned by rote than it is to forget what you once understood. What is more, should you forget something that you now understand, it is not difficult to review it at some later time, while if you forget something learned by rote, you find that it is necessary to relearn it completely. In fact, it is almost as if you had never learned it before. So apparently, learning with understanding is a better kind of learning. But just how do you go about it?

First, you start by studying a little bit of the lesson — as much as you think you can take in one bite. Just how much a little bit

is depends on you, on how well you read, the size of your vocabulary, or previous experience, and how quickly you learn. So, a little bit may be a sentence, a paragraph, or one of the numbered sections you find in the lesson. Just how much it is for you is something that you will have to find out for yourself.

So we come to our next step in studying a lesson. Figuratively, we take one bite out of the lesson, chew on it a little while, and see if we can swallow and digest it. Actually, we slowly read a sentence or a paragraph, or whatever your little bit turns out to be. It may take two or three readings in some cases before the sentence or paragraph gives up its full meaning to you. Once you think that you understand its message, that you know what it is all about, close the lesson booklet and in your own words, see if you cannot explain what you have just read. If you can put the meaning of what you have read into your own words, then you understand it. By the same token, if you cannot explain what you have just read in your own words, you don't understand it. It is as simple as all that. If you find that you cannot explain what the sentence or paragraph is all about (if you don't understand it), it will be necessary for you to study the sentence or paragraph some more. However, as soon as you *do* prove to yourself that you *do* understand what you have read, then pass on to the next sentence or paragraph — take another bite out of the lesson. When you come to a formula, work out the arithmetic of it yourself. Prove to yourself that any examples that may be given in the lesson on the use of the formula actually work out the way the lesson says they do. This helps you to understand the formula and also teaches you how to use it.

If you haven't time enough to study the lesson in one sitting, which will be the case in most of the lessons in this course, be sure to review what you have last studied before you go on to the next section. When at last you come to the end of the lesson, review the lesson before you answer the questions of the Lesson Assignment, which appears at the end of each Theory and Experiment Lesson booklet. One way in which

you can review is to turn back to the title page of the lesson and see if you can remember what each of the sub-sections is about.

Using Small Amounts of Time for Study.

Some of our students have jobs where they have free periods of five, ten, or fifteen minutes in length, periods that are normally wasted, periods that could easily be used for study. Such periods of time may be used in learning the definitions of technical terms, in learning formulas, and how to apply them, or even in learning small sections of the lesson itself. If you have time for reading a newspaper, a magazine, or a comic book, it might better be spent in such study. One advantage of study in this way is that you continue to think about what you have just learned for a short time after you have actually stopped studying and in this way you help to impress it upon your mind. So that three 10-minute periods of study are sometimes worth considerably more than a half-hour of continuous study.

One way to make use of small periods of time is to make notes on ordinary 3x5" file cards. For example, a formula that you want to learn may be put on a file card. Definitions can be treated in the same way, or you can summarize a section of the lesson on a file card. These file cards fit easily into your pocket and may be slipped out at any time you have a few minutes for study. What is more, you can use the same cards to help you review the lesson before you do the assignment.

Answering Questions. When you believe that you know the lesson well enough to answer the questions of the assignment, then turn to the end of the booklet and get to work. However, here are some suggestions that may add points to your grade. *Read each question completely before you answer it.* For example, if you are answering multiple choice questions, do not stop reading the alternative answers when you come to one that you think is the correct answer. Instead, read all four choices before you make your choice. *Do not jump to conclusions.* Read each question carefully. For example, if it is a true-and-false question, make sure that

you understand the statement before you mark it true or false, and remember, with such questions, a statement is true only if it is *always* true. That means, that if a statement is made that is true sometimes and untrue at other times, the answer must be that the statement is false. Reading the question carefully is also important when answering problems. Make sure that you understand what the problem wants you to find. Make sure that the figures that you use are those as given in the problem and then go ahead.

When your assignment is finished and you have answered all the questions to the best of your ability, send it to us for grading. The instructions for mailing an assignment are given on page 1 of each lesson assignment. Before you mail the assignment make sure that you have printed your name and your address and have written the date and your student number in the spaces provided for them at the top of the first page of the lesson assignment.

Doing Experiment Lessons. An Experiment Lesson immediately follows the Theory Lesson in this booklet and in the other Theory Lesson booklets of this course. The first two Experiment Lessons are designed to give you instructions and practice in soldering. Soldering is an easily learned, but important, skill that you will use throughout your electronics career. Later Experiment Lessons are related to the Theory Lessons. When the Theory Lesson and the Experiment Lesson are so related, it is a good idea to study the Theory Lesson, perform the experiments, and then to answer the questions in the Lesson Assignment. Sometimes, the lesson assignment includes questions that cover some of the work done in performing experiments. So you can see why we suggest that you perform the experiments before you do the assignment. Before performing experiments or jobs of any Experiment Lesson, carefully read the entire Experiment Lesson, so that you may know what you are expected to do. Each Experiment Lesson contains some information which you must read and understand before you can perform the experiments or understand what you are doing.

Be Careful
DON'T
CAUTION
DANGER
HIGH VOLTAGE!
WARNING

don't take chances

Fig. 7

For example, Experiment Lesson 1 starts off with telling you what the object of the lesson is. This is followed by some information about soldering, flux, soldering irons, etc.

Once you understand what you are expected to do in an Experiment Lesson and have assembled all of the materials needed for the experiment, then go ahead and perform each job or experiment as the lesson tells you to do. Wherever you are told to be cautious and to take special care while performing an experiment, be sure to follow the instructions to the letter. There is no place in this course where you will be cautioned needlessly. Remember that the successful electronics technician is the one who has learned that it does not pay to take chances.

Services Practices Booklet. The purpose of the Service Practices booklet is to give you the kind of information that you need to do radio and television servicing. It's the kind of information that you would receive from the experienced radio and television serviceman. The Service Practices booklets start off by telling you how to identify receiver parts, how to use tools, how to identify radio hardware, how to install a receiver, etc. As you progress in the course, the subject matter of these booklets becomes more complicated, but by the time you receive each of these booklets, you will be prepared to understand the type of information it contains. These booklets however were not designed for you to study in the same way as you would study a Theory Lesson. It is understood that you will read them and then keep them in a safe place where you can refer to them when the need arises. For example, it would be downright

silly for you to sit down and try to memorize the names and shapes of the radio parts shown in Service Practices 1. But when you come across a part that you cannot identify, you may be able to get help by referring to the Service Practices 1 Booklet. Service Practices 5 tells you how to erect an antenna for a radio receiver. It is given to you in the third lesson group so that whenever you should have the need for information about installing such an antenna you will be able to find it in the Service Practices 5 booklet.

SUMMARY

1. When you first receive the Lesson Material, read it quickly as you would a newspaper to get the gist of it.

2. Then study a paragraph at a time. When you finish a paragraph, cover it up and try to put down in a few words the meat of the paragraph. If you can do this, proceed to the next paragraph. If you cannot, you should re-study it again until you understand it.

3. After you have *studied* all the paragraphs and completed the entire lesson you should try to answer as many questions as you can without referring back to the text.

It is suggested that you make your marks initially in pencil.

4. For those questions which you do not know the answer, or are not sure of the answer, you should refer back to the paragraphs and *re-study* them again.

5. After you have answered the questions to the best of your ability, you should ink in your answers, and send them to us for grading.

6. When you receive your graded Lesson Assignment, you should check to see what errors were made, if any. Wherever you have a mistake, you should once again go back to that section in the text and re-study it in order to determine why you did not get the correct answer the first time.

7. If, after performing all the previous steps you still do not understand a specific question, you are at liberty to write us for additional information or explanation.

8. The mathematics you will encounter in this Course can best be learned by doing the problems and similar problems many times in order to understand the technique. It is chiefly a question of practice. There will be a small math booklet sent with Study Group 5.
